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NOTES ON THE BREEDING HABITS OF THE WILLOW-GROUSE (*LAGOPUS LAGOPUS*) AT THE MOUTH OF THE YENESEI RIVER, SIBERIA.

By M. D. Haviland.

(Plate II.)

During the summer of 1914, as one of the party of Miss Czaplicka of Oxford, I visited Golchika, the most northerly village of the Yenesei River. The bird-life of the district has many features of great interest to ornithologists, although in that latitude (72°) there was little that was typically Asiatic in the avifauna. Out of the thirty-seven species of birds that I observed there, all but one were represented on the British lists (though in one or two cases by a different subspecies). The only bird not so represented was the Willow-Grouse (*Lagopus lagopus*),* the subject of these notes.

The Willow-Grouse (the "balshaya Kuropatka" or "big partridge" of the Siberians) was frequent on the tundras of the Yenesei estuary, though nowhere very abundant. It was generally to be found in the more marshy spots where a trickle of water ran down a gulley and spread into a small swamp which was covered with knee-deep willow scrub. Early in the season when the snow is melting, I imagine that the birds feed largely on the buds of the willow. The crop of a male shot in such a place on July 12th was stuffed full of them. I never saw any birds in the drier and barer parts of the country. Even the nests and young broods were always to be met with close to water. The tundra, although for many miles around the river its variations in altitude do not exceed 150 or 100 ft., has most distinctive gradations in avifauna. To take an extreme case: the highest points are occupied by Wheatears, Shore-Larks and Dotterel; the lower and more swampy levels by Red-throated Pipits and Willow-Grouse; while the marshes are full of Divers and Phalaropes. But in that flat country the margins between one environment and another are so fine that you may occasionally see a Dotterel breeding in the same situation as a Snipe might choose; and I have found a Willow-Grouse, which had missed its habitat by perhaps thirty feet and was nesting in the marsh herbage on the river bank.

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* B. O. U. list.

This nest, which is the one shown in the illustration, was found six miles from Golchika. I spent the night of July 11th in bird-nesting by the light of the midnight sun, and about 11 p.m., my companion, a Russo-Siberian from the south, flushed an "Abba," as the Samoyedes call the bird, from thirteen eggs. She ran from the nest, feigning a broken wing in true Partridge style, and Vassilli immediately fell into the trap. He cocked his gun and ran after the bird, expecting each instant to obtain a better shot. The old Grouse lured him thus out of sight of the nest, and then boomed away unhurt. I never saw a more effective hoax more successfully carried out, and the dupe came back looking very sheepish, with his gun undischarged.

I did not arrive at Golchika until the end of June, and as the birds by then were already mated, I did not see anything of the courtship of the species. From my own observation I should say that the cock bird takes no part in incubation, although he assists afterwards in the rearing of the young. Frequently during the first part of July I flushed a solitary cock bird from the willow on the tundra, the inference being that the females were then upon the nest. The flight and alarm note are so like those of *Lagopus scoticus*, that if I shut my eyes, I could well have believed myself among the heather of a Yorkshire moor instead of some thousands of miles away in the heart of Arctic Asia. On the wing, however, the bird appears much more conspicuous than the Red Grouse, owing to its skewbald colouring. Birds shot in the middle of July were still moulting their winter plumage.

On July 25th I surprised a pair of Grouse and their brood in a swampy valley, much frequented by Red-throated Pipits and mosquitoes. The "cheepers," which were partly fledged, scattered into the willow scrub. However, I captured a couple and imprisoned them in my camera case. Their calls soon attracted the old bird, who was watching from a knoll not far away, and she ran up to the spot. By the use of a reflex camera and a long-focus lens, I was able to secure a series of pictures of her as she crept round me, puzzled to locate the whereabouts of her distressed brood. Meanwhile, the male bird also approached and testified the greatest anxiety, but he never came near enough to allow me to photograph him. While the young broods are fledging, they are never found far from the neighbourhood of water. Probably, like Plovers, they require to drink and bathe frequently.

Mr. A. Trevor-Battye ('Ice-bound on Kolguev,' p. 430), writing of the habits of this bird on Kolguev Island, says: "On July 30th saw eight cocks together, and from then onwards they continued packing." On the Yenesei I never saw more than two Grouse together at the one time, even in August, when the young birds must have been strong upon the wing. As I have said, the birds were not very abundant. Each likely locality seemed to be inhabited by a single family, and they may well either have escaped notice in that immense country, or else migrated at once to the highlands inland, in search of ripening berries.

I also found the Rock-Ptarmigan (*Lagopus rupestris*) on the tundra about twenty miles from Golchika on July 19th. Two males and a female were shot together from among the willow scrub on a high ridge of the tundra. The birds were very tame, and I saw no sign of nest or young, although the female had an incubation spot. This was the only time that I saw the "malenki Kuropatka," as the Siberians call it, but Seebohm, who visited Golchika in July, 1877, and whose list of birds of the district is not very comprehensive, records it from close to the river.

The Willow-Grouse is the last bird (with the exception of the Snowy Owl (*Nyctea nyctea*)) to leave the Yenesei estuary before the winter. Mr. Trevor-Battye (*op. cit.*, p. 430) states that this bird winters on Kolguev and forms an important winter food of foxes. I have the authority of the Siberians for the statement that the Willow-Grouse does not winter on the Yenesei below the forest growth. It was still common at the end of August, when most other birds had left for the south, and it was frequent in the Breokoffsky district, about two hundred versts higher up the river, throughout September. The natives said that it sometimes lingered on into October, when the blizzards finally buried the willows.

THE HABITS OF THE FOUR-HORNED SPIDER-CRAB.

By H. N. Milligan, F.Z.S.

Our knowledge of the habits of the Four-horned Spider-Crab (*Pisa tetraodon*) is exceedingly meagre, partly no doubt because this crustacean is rarely to be seen in aquaria, and the following notes upon the subject may therefore be of interest. These notes are the result of constant observation of about a dozen individuals of this Spider-Crab which have lived from time to time in one or other of the fourteen marine aquaria at the Horniman Museum. Although the facts here recorded relate entirely to these captive individuals, I have tried to add to any usefulness the present paper may possess by referring in their appropriate places to such of the few published records which seem to bear upon those habits I have described.

Bell has drawn attention to the "extremely slow and measured" movements of the Four-horned Spider-Crabs *; but their movements are not only slow, they are remarkable for an exceeding cautiousness. Even after several months of captivity these Spider-Crabs will immediately cease to eat or to walk if the front of one of their aquaria (each of which is thirty-one inches long, eighteen inches from back to front, and fifteen inches deep) be abruptly approached. I have seen individuals which have been engaged in tearing food suddenly stop and remain quite still for several minutes with the food (say a piece of seaweed or a worm) suspended between mouth and outstretched claw, because I have made a sudden movement of my arm in front of the aquarium. They may be seen to behave in this way when on the rocks at the back of the tank, ten or twelve inches away from the glass front, and this suggests that the sight of these Spider-Crabs must be comparatively good. It may be pointed out that the aquaria receive their light from electric lamps above, and that no shadow could fall across the Spider-Crabs from my arm; therefore, it could not be a shadow which alarmed them.

It is to be observed that the behaviour of a Four-horned

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* T. Bell, 'A History of the British Stalked-eyed Crustacea,' p. 25.

Spider-Crab differs, in my experience, according to whether the animal is alarmed whilst standing in an exposed situation, or whether it is alarmed in one of its favourite positions, wedged into a hole or clinging closely to the under surface of a projecting piece of rock. If a *Pisa tetraodon* be touched with a rod when in the former position, it at once presses its body as closely as possible to the ground, and then begins to sidle away as quickly as caution permits. If, however, it is in one of the latter positions, it does not usually seek safety in flight, but presses its body tightly against the rock and remains perfectly still, resisting with all its strength any attempt to move it from side to side or to pull it away from the rock. Its behaviour in this respect, as I have frequently satisfied myself by experiment, is the same whether its body carries a disguising mass of seaweeds or not. A Four-horned Spider-Crab may often be seen clinging to the under surface of a jutting piece of rock which would appear to be far too smooth to enable it to obtain a hold, but the comb-like row of spines on the inner margin, and the sharp-pointed tip, of the terminal joint of each of the eight walking legs, enable the animal to obtain a good and very ready grasp. One Spider-Crab hung (for at least a day, I believe) after death to the under surface of such a jutting rock, and it was found that some of the rows of spines had been introduced before death so cunningly into holes and depressions that each leg required to be detached with some care. Carrington and Lovett mention the "very secure" hold of this Spider-Crab, remarking that the sharp end joint can be clenched back upon the next one,* but they do not mention the use of the spines. The sharp point of the end joint and the spines (which are shown in fig. 2) are especially useful when the animal attempts a characteristic method of escaping from an enemy, or from the annoyance of being touched with a rod. If the Spider-Crab is exposed on the rocks when so attacked, it sidles away in the manner described above, but immediately it reaches the edge of the rock it deliberately turns over the edge, and, once beneath, remains perfectly still, clinging upside down.

The attitude assumed by a Four-horned Spider-Crab when at rest on a horizontal surface is shown in fig. 1. The four pairs of walking legs rest upon the ground, the body being carried obliquely, while the two claws are held in such a way that they resemble inverted V's, and the animal has a peculiarly watchful aspect. Sometimes the anterior and longest pair of walking legs are raised above the ground and stretched out on either side. Very frequently when at rest against a vertical rock the Spider-Crab will place itself in such a position that its body is vertical, the ventral surface of the animal being pressed against the rock, and its hinder portion, together with the three hinder pairs of walking legs, resting upon the ground. The long first pair, and sometimes also the second pair, of walking legs are then spread out as straight as possible to right and left of the Spider-Crab. When the Spider-Crab assumes this attitude against a rock it is very difficult to detect the animal. A Spider-Crab may sometimes be found in the morning standing in this posture, not against a rock but against the glass front of the aquarium. If such a Spider-Crab be touched, it presses its body against the glass, just as it would have pressed it against a rock, and then begins to sidle away. It does not sidle away over the floor, but along the glass front, of the aquarium, in spite of the alarm which it must feel when the glass is tapped immediately in front of its eyes as it moves along. It was mentioned above that the Spider-Crab will notice the movement of an arm ten or twelve inches away, and it must be well aware of a finger tapping the glass in front of it. The fact that it will press along the glass front, instead of moving away across the floor of the

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* J. T. Carrington and E. Lovett, "Notes and Observations on British Stalked-eyed Crustacea," 'The Zoologist,' vol. xxxix, 1881, p. 359.

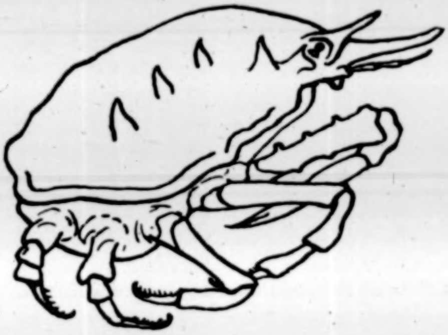

Fig. 1.—An adult female Four-horned Spider-Crab in a characteristic resting and watching attitude. The hairs are not represented.

tank, shows how deeply rooted is this instinctive attempt to escape an enemy by creeping close to some surface, which would normally be the rock it so much resembles in colour. After eight or nine months in an aquarium the movements of this Spider-Crab are as slow and cautious as when the animal was first introduced, and it never seems to acquire the tameness and confidence so often shown by the Shore-Crab in captivity.

Owing to its olive brown, or sometimes reddish brown, colour, and the irregular surface of its carapace, the Four-horned Spider-Crab is difficult to detect, even when it is standing fully exposed on the brownish rocks of the aquarium. On two or three occasions I have been quite unable to find a certain individual amongst the rocks, even in the small aquarium whose dimensions are given above, and, concluding that it had escaped from the tank during the night, have afterwards found it clinging to the under surface of a rock at which I must have looked in my first survey. It is interesting to note that Aurivillius mentions a somewhat similar experience with *Hyas*.* I wished to find out whether the Spider-Crabs would voluntarily expose themselves on light-coloured sand, upon which their brown bodies would stand out conspicuously, or whether they would avoid it and remain on the rocks with which their colour harmonised. An experiment was therefore made with two individuals which had lived for several months in a tank, the back of which was covered with dull brown rocks and the floor with brown pebbles. The Spider-Crabs were removed to a tank whose back was covered with similar dull brown rocks, and the floor with exceptionally light-coloured sand. It was found that in the second tank the Spider-Crabs, although they exhibited, as in the first tank, a decided preference for sitting amongst the rocks, were nevertheless quite as frequently to be seen on the sand as they had been on the pebbles; and there was no marked avoiding of the sand such as I had certainly expected to find.

It is well known that the different species of Spider-Crabs are in the habit of attaching to their bodies foreign materials which act as disguises. The materials which have been used in the Museum aquaria by the Four-horned Spider-Crab are green and brown seaweeds of various kinds, and *Sertularia operculata*, and *Bugula turbinata*. Other individuals have borne *Halichondria panicea*, *Spirorbis*, and (in two cases) the golden-yellow *Botryllus gemmeus*; but these foreign bodies were already on the Spider-Crabs when they were obtained from the sea. Aurivillius* records the use of hydroids and algæ, and Carrington and Lovett † the use of *Plumularia falcata*, ‡ *Alcyonium digitatum*, and *Halichondria panicea*. Schmidtlein § mentions the use of sponges, *Alcyonium*, *Sertularia*, *Antennularia*, *Flustra papyracea*, and colonies of synascidians in "*Pisa*-species," but does not specifically mention *P. tetraodon*. One of the individuals observed by me which bore a mass of *Botryllus gemmeus* also carried a white plume of dead *Bugula turbinata*, of about an inch and a half in length, on its carapace; and it may be remarked that the golden-yellow *Botryllus* and the white *Bugula* were so conspicuous that the brown Spider-Crab itself was easily overlooked. The plume of *Bugula* fell off, or was knocked off, the back of the Spider-Crab during the night, and, after lying for a couple of days on the floor of the tank, was replaced by the Spider-Crab. Although the Spider-Crabs will place disguising materials upon their bodies during the daytime, it is after dark that they prefer to work, and it is then they work most quickly. Two females which lived together in an aquarium were given three masses of *Sertularia operculata*, each of about the size of an open hand, at 10 a.m. They examined the *Sertularia*, and seated themselves in the midst of it, but they made only few, and but partly successful, attempts to fasten it amongst their hook-like hairs in the daytime. On the following morning, however, it was found that both were completely enveloped in masses of the hydroid, which they had fastened to their bodies.

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* C. W. S. Aurivillius, "Die Maskirung der Oxyrrhynchen Dekapoden," 'Kongliga svenska Vetenskaps Akademiens Handlingar,' 1 Häftet, No. 4, Band xxiii, 1889–90, p. 11.

The small hook-like hairs upon the carapace and backs of the legs to which the disguising materials are attached have often been described in the different species of Spider-Crabs. It should, however, be observed that the seaweeds and hydroids and other disguising materials in the Four-horned species (at all events in those studied by me) are not spitted by the Crab on the hooks, or roughly entangled in them, as seems to be often imagined; though it is possible that materials are sometimes caught on the hooks of a passing Crab, and I have seen a flat piece of the thin green *Ulva lactuca* really spitted on two of the hairs of the leg of one individual. The hooks are not scattered over the surface of the body but form regular tracts, whose arrangement is shown in fig. 2. It will be seen that the hooks of each tract tend to form "alleys," the hooks of opposite sides of an alley generally facing inwards. The thin ends of the disguising materials are, as a rule, thrust along the alleys made by these opposed hooks, and if one of the Four-horned Spider-Crabs be examined it will usually be found that the material can easily be moved in and out of an alley. In the case of flat pieces of seaweed which are too large to be thrust into an alley, one corner of the weed is usually twisted round in a spill-like manner, and the narrow piece so formed is thrust into the alley. The hooked

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* *Op. cit.* p. 49. † *Loc. cit.* p. 359. ‡ = *Hydrallmania falcata*.

§ R. Schmidtlein, "Beobachtungen über die Lebensweise einiger Seethiere innerhalb der Aquarien der Zoologischen Station," 'Mittheilungen aus der Zoologischen Station zu Neapel,' Erster Band, 1879, p. 23.

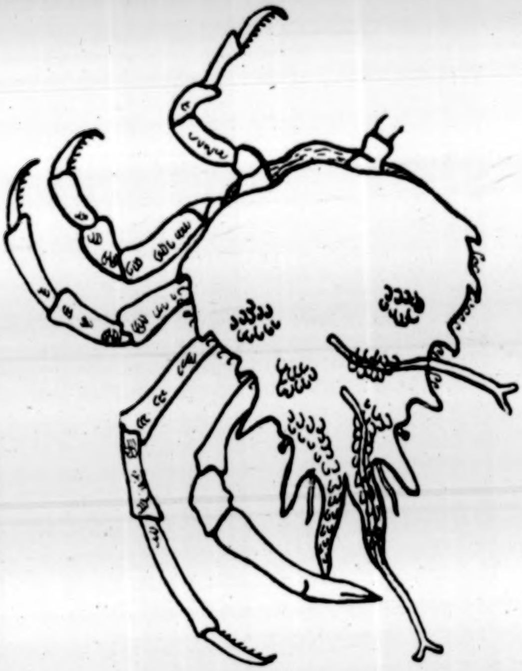

Fig. 2.—Outline of the body and right limbs of an adult female Four-horned Spider-Crab, mainly to show the tracts of hook-like hairs and the way in which weed is thrust into two of the alleys. The other hairs are not shown.

hairs on and in the region of the rostrum form two especially long and strong rows, and it is here that the largest and heaviest masses of seaweed are placed by the Spider-Crab. Indeed, the disguising material fastened on this region is usually of such a length that it stands out, often for as much as four inches, in front of the head in a peculiar and characteristic manner. The *Halichondria*, *Spirorbis*, and *Botryllus* mentioned above were actually attached to, and growing upon, the Spider-Crabs, but in all the other examples which I have been able to examine, the ends of the disguising materials were merely thrust in the alleys; and it is doubtful whether the Spider-Crabs had placed upon themselves any of these three animals, the two last not being attached by hooks at all, but lying flat on the hinder part of the carapace. Bell declares that there is no doubt that plants actually grow upon *Pisa tetraodon*, and are attached by roots,* and other writers have adopted this statement. In specimens preserved dry the disguising materials are often stuck upon the body of the Spider-Crab in such a way as to give the impression on slight examination that in life they actually grew on the crustacean. The point deserves investigation by one who can study numerous fresh specimens. Aurivillius, who gives a description of the distribution of the hooks in *P. tetraodon*, and a figure of their arrangement in *P. armata*, says † of the former species: "Die untersuchten Exemplare sind mit Hydroiden oder Algen reichlich maskirt; es sind dabei die Doppelreihen der Rostralhäkchen zur Befestigung wahrer Federbüsche von Hydroiden verwendet, deren Spitzen allesammt nach vorne frei hervorstehen, die abgebrochenen Enden nach hinten in die Furche zwischen den Häkchenreihen gelegt." ‡

There appears to me to be little doubt that the arrangement of the hooks in alleys not only affords the Spider-Crab a ready means of affixing disguising materials upon its body, but also of enabling it to escape by sudden detachment of the materials if they should be seized by an enemy. Their use in the latter way can readily be tested by taking hold of the disguising mass and giving it a gentle pull, when a portion of it will usually come away in the fingers, the animal at the same time sidling off in the opposite direction. Indeed, it is often sufficient simply to seize the mass, when the Spider-Crab will itself give a pull in order to get free. It is usually the long outstanding mass on the rostrum which is presented to the enemy as the Spider-Crab retreats with its peculiar sidelong gait.

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* *Ibid.* p. 25.

† *Op. cit.* p. 49.

‡ "The specimens examined are richly masked with hydroids and algæ; the hydroids are fastened to the double series of rostral hooks in the manner of feather-brushes whose points all stand out freely in front, while their broken ends lie in the furrow between the series of hooks behind."

The Four-horned Spider-Crab feeds readily upon seaweeds of various kinds. It will eat in the daytime, especially if it is hungry, but it is after nightfall that it prefers to feed. The quantity of seaweed devoured may be measured by the rapid disappearance of the seaweeds in the aquarium and by the masses of fæces daily deposited. It may here be mentioned that on one occasion, when there was a shortage of seaweed for a few days, two Spider-Crabs which were living in a tank at that time were given some of the common freshwater Canadian weed (*Elodea canadensis*), which they cut up and ate. Bell mentions that these Spider-Crabs would congregate in vast numbers in the prawn and lobster pots at Bognor, attracted, he thought, by the garbage used as bait; * but I have never been able to get any of them to eat raw beef, and only occasionally, and reluctantly, to take dead fish. All the individuals studied by me have been females, or males whose claws had not attained their full size; and it is possible there may be some difference between the habits of the younger and older Spider-Crabs, or between those of the males and females, the adult males being bold enough to approach and feed upon substances likely to attract animals which might attack the *Pisa* itself, while the younger males and females venture only to take food which can be obtained with less risk. Indeed, Bell remarks † that those found in the pots were much larger and finer than any he had seen elsewhere. I have observed that the masses of seaweed used as a disguise may also serve as a food-reserve if the animal is unable to obtain sufficient to eat. One individual, for example, enveloped itself in a mass of seaweed some four inches in height, and it gradually removed and ate the whole mass in the course of the following fortnight. Schmidtlein mentions ‡ that he has seen "*Pisa*-

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* *Ibid.* p. 24.

† *Ibid.* p. 24.

‡ *Loc. cit.* p. 23.

species" in the aquarium at Naples trimming and plucking off one anothers hydroids and sponges to use as food.

Although they would not take beef, I found that the Four-horned Spider-Crabs would, in the absence of seaweeds, sometimes eat dead or dying *Sabellæ*, and also, though not eagerly, garden worms. The *Sabella* was usually removed from its tube before being given to the crustaceans, but on one occasion there was placed in an aquarium, which contained three adult female Spider-Crabs, a healthy living *Sabella* in its leathery tube, which was about four and a half inches in length and one sixteenth of an inch in diameter and firmly attached to a shell. A female *Pisa* which happened to walk over the shell immediately seized the *Sabella* with its two claws and tore the worm into two parts at about an inch and a half from its attachment to the shell, in much the same way that a man would twist and tear a piece of paper across. The Spider-Crab then lifted the loose, larger part in one claw, placed the proximal end in its mouth, and proceeded deliberately to eat along the tube. As fast as the lower end of the tube was bitten off by the Spider-Crab, the worm moved out of its tube through the opening at its upper end. The Spider-Crab now turned the tube round; the worm retreated almost wholly into the remaining part of its tube;* the Spider-Crab then pinched the tube tightly with both its claws in such a way that the worm was held firmly and was unable to move upwards or downwards in its tube, about half the length of the massed gills hanging limply out. It is difficult to decide whether this process of imprisonment of the worm by pinching its tube was an instinctive or accidental action on the part of the crustacean. The Spider-Crab again began to eat along its prey, biting through worm and tube together. About half an hour after seizure of the worm the Spider-Crab had disposed of all but about an inch of the upper end of the tube and the gills. It now held out the remainder of the tube at arm's length in the characteristically indifferent manner in which these Crabs hold out unwanted food which they have picked up and are about to throw away again. On looking at the Spider-Crab about three hours later, however, I could not see any trace of the worm or its tube, and presume the crustacean had eaten them, though it is probable that the gills had simply been broken up and scattered amongst the pebbles and had not actually been swallowed. By this time the crustacean had travelled for a distance of about a foot from the place where it began its meal, and the proximal inch and a half of empty tube still remained projecting from the shell to which it was attached. By the next morning this piece also had disappeared, having, I suppose, been eaten by the same, or another, Spider-Crab.

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* The *Sabella* is considerably shorter than its tube.

A few days later a *Sabella pávonia* in a tube of about nine inches in length and less than a quarter of an inch in diameter was placed on the floor of the same aquarium. The widely-spread gills and a very small portion of the body of the worm were protruding from the tube, when a female *Pisa* slowly and quietly approached and took hold of the exposed part of the body of the worm, immediately beneath the gills, with its left claw. It is remarkable that a *Sabella*, which usually darts back into its tube on the slightest alarm, should have suffered itself to be caught by so slow and clumsy an enemy as a Spider-Crab, but perhaps the pressure of my fingers on the lower part of its tube, when I was carrying it to the aquarium, had made the worm reluctant to withdraw. The Spider-Crab now began to tear off the gills of the worm in bunches of two, three, or four, with its right claw, and to hold them to its mouth and bite them, although, apparently not finding them palatable, it did not swallow them. After tearing off, attempting to eat, and rejecting, several bunches in succession, the Spider-Crab stopped. In the meantime the worm had made frequent violent attempts, which were sufficiently vigorous to cause its tube to swing about in the water, to jerk itself into safety further in its tube. The Spider-Crab now seemed not to care to resist these attempts, although it did not release its grasp of the worm, and presently the latter had pulled itself so far down the tube that the Spider-Crab looked as though it had a very long sleeve on its claw. When, however, it began, two or three minutes later, to walk away over the rocks, it apparently found this sleeve inconvenient, and, withdrawing its limb, it allowed the tube to fall to the ground. The tube lay untouched on the floor for several days, but when I took out the worm and gave it to one of the Spider-Crabs it was readily eaten. In the case of the first-mentioned tube the Spider-Crab dropped most, perhaps all, of it as it bit through it. After the worm had been taken from the second tube, the latter was cut up into several short lengths and thrown back into the aquarium. They lay untouched on the floor of the tank for three weeks, and it may therefore be concluded that the Spider-Crab will bite through the tube only in order to reach the worm, and not in order to eat the tube itself. I have seen a Spider-Crab tearing and eating two ascidians, each of which was about an inch and a quarter in length.

On the night of February 17th–18th, 1915, a number of bright vermilion eggs were laid on one of the horizontal rocks in the aquarium containing the three female Four-horned Spider-Crabs mentioned above. The tiny eggs were not in a mass, but were thinly spread, and gave, when I first caught sight of them on the morning of the 18th, the impression that some paint had been splashed over the rock. I estimated their number at about 2500. One of the Spider-Crabs, which may or may not have been the mother, was standing over the eggs and shovelling them into her mouth with her claws in her usual slow and deliberate manner. About an hour afterwards another individual joined the first and also began to eat the eggs. The Spider-Crabs were driven away, but they returned later. The eggs rapidly dwindled in number under these attacks, and on the 22nd there were only a few, which had fallen into holes and cracks, to be seen. The worm-shaped fæces of the Spider-Crabs were tinged with vermilion during these few days. About two or three hundred more eggs were laid in the same tank on the night of February 24th–25th, but they were all eaten by the Spider-Crabs, and none were to be seen by the 27th. On the night of May 14th–15th, about a thousand vermilion eggs were laid, and these also disappeared speedily, though in this case I did not actually see the Spider-Crabs eating them. The two last lots of eggs were littered over the rocks, as the first had been, and were not in masses. I examined each female whenever eggs were deposited, carefully turning back the abdomen in order to do so, but in no case did I find any eggs retained between the thorax and the abdomen. On March 26th the same Four-horned Spider-Crabs were offered a mass of eggs which had been obtained from the abdominal limbs of a female of the Common Spider-Crab (*Hyas araneus*). About half of these eggs were eaten by the Four-horned Spider-Crabs, but they did not seem to eat them with the same avidity as they had eaten their own. Perhaps the fact that the eggs of the *Hyas* were not fresh, but well advanced in development, may have had something to do with this. A number of eggs, which were nearly ready for hatching, of the Sea-bullhead (*Cottus bubalis*) were refused altogether.

It is familiar to those who have kept in aquaria certain crustaceans, such as the Shore-Crab, the Velvet Crab, the Crayfish, and the Common Prawn, that these animals will select convenient holes or corners amongst the rocks which they use as permanent resting places, from which they only venture to get food, and to which they retreat when alarmed. None of the Four-horned Spider-Crabs observed by me have had such special resting places. They will remain almost motionless during the daytime in one spot, but after dark they move away to feed, and then retire to a fresh place when daylight returns. This is, of course, intelligible when it is remembered that the Spider-Crab carries a disguising mass of seaweed, while the Shore-Crab, Crayfish, and Prawn have no such protection.

Bell says of the Four-horned Spider-Crabs that, "notwithstanding their timid and lazy character, they seize the object of their anger by a sudden and unexpected snap, and nip with great force, holding on with extraordinary firmness and tenacity, although unable, from the bluntness of their pincers, to inflict a wound."* None of the females or small-clawed males observed by me have attempted to bite or to strike with their claws, however much they were annoyed, and I have frequently taken fresh and healthy individuals in my fingers for examination without their making any hostile demonstration. The females, for example, whose abdomens I turned back in order to look for eggs, made no attempt to defend themselves. Bell's remarks may perhaps refer only to adult males, in which the claws are much larger than they are in females and immature males.

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* *Ibid.* p. 25

THE "LAPILLUS" IN FISHES.

By Colonel C. E. Shepherd (Indian Army).

"Lapillus" is the name given by scientists to that otolith found in the *recessus utriculi* portion of the ear-labyrinth of teleostean fishes. Up to the present time no special notes seem to have been published regarding this stone. The "Astericus" was treated of in the 'Zoologist' for February, 1910; and many sagittæ are shown, and their peculiarities, when out of the common, pointed out, in the 'Zoologist' for August, 1910; in the March and April numbers for 1914, and January, 1915. In the illustrations of the four latter papers many figures of lapilli are incidentally shown, but this stone is, as a rule, so small that nothing definite is seen; some enlarged drawings may enhance interest in them. The purpose they fill and the need of their presence in the auditory labyrinth of a fish is at present indeterminate. They have a variety of forms; Mr. Higgins,* who made a collection of otoliths about the middle of last century, calls the lapillus "the superior otolite" (*sic*), because it occupies a spot in the brain-cavity of a fish a little above the other otoliths. He says of the lapillus that it is "usually more globose, smaller" (compared to the sagitta, he means), "and rather porcellanous, and varies considerably in form, being rounded, triangular, stellate, or hastate." To which may be added, some resemble closely the shape of a seed in the grape. The place of the lapillus in the *Acipenseridæ*, as exemplified in *Acipenser sturio*, is taken by otoconia (ear-dust) instead of a solid otolith (ear-stone); the otoconia † being separate crystals of carbonate of lime.

In the present paper it is as well to take first those fishes that have a palpably large lapillus. The first family, then, to be reviewed is the

Ceratodontidæ.

The lapillus in *Neoceratodus fosteri* (fig. 1), the "Burnett Salmon" of Queensland, Australia, is of good size, slightly concave on the outer face, coming to a point at the posterior end, and having, in the specimen obtained, on the lapillus from the right side of the head an excrescence like a minute hillock in the concave plain at the anterior end. In another specimen, in the Royal College of Surgeons Museum, this minute hillock has a hook-like shape. The otoliths in these specimens are of a very chalky texture, and the markings do not show very plainly.

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* See Jour. Linn. Soc. vol. ix. No. 35, January, 1867.

† Illustrated in 'Zoologist,' January, 1915.

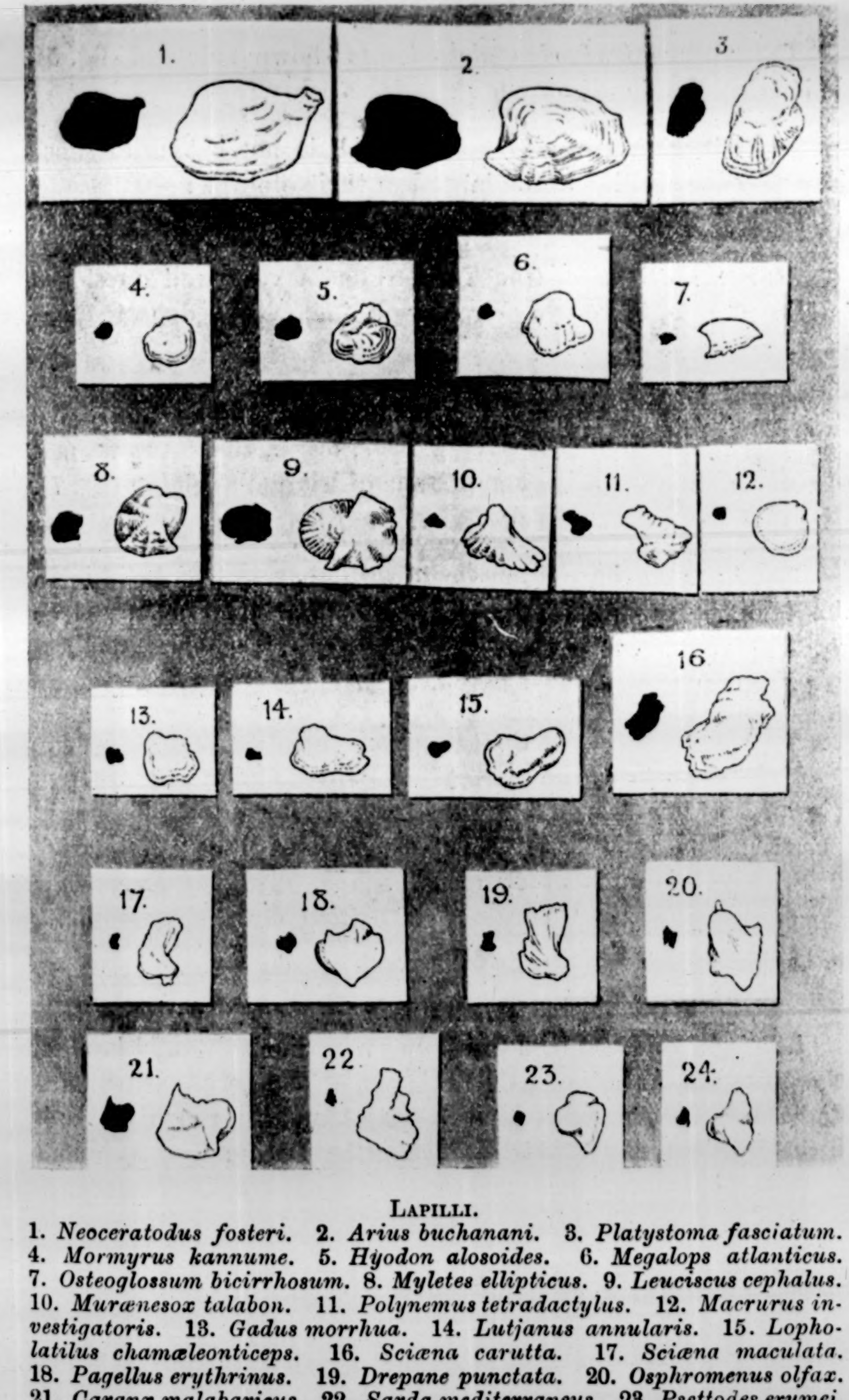
Next in order may be taken those fishes in which the lapillus is the largest of the three otoliths on one side of the head; this occurs in the *Mormyridæ*, *Hyodontidæ*, *Siluridæ*, and *Loricariidæ*. Beginning again with those that have the largest lapillus, the first family to be described is the *Siluridæ* or Catfishes.

SILURIDÆ.

In the marine members of this group the lapillus is a really big stone, whilst some of those living in fresh water have, for the size of the fish, a very small one. A contrasting instance is given in the 'Zoologist' for January, 1915. The lapillus of *Arius buchanani* (fig. 2) is a large stone; it is the same with all the *Ariidæ* and the allied genus *Ælurichthys*. The lines of growth in the specimen figured, and also in others of the family, are plainly visible owing to the size of the stone. In other fishes, the stone being small, these lines do not show as a rule. *A. gagora* has a large stone semi-globular as to one-half, the other half stretched out at its outline and coming to a blunt edge. *Ælurichthys gronovii* has a stone with one part of its outline projecting into a distinct point. *Platystoma fasciatum* also has a large lapillus (fig. 3) differing considerably in shape from those of the *Arius* family. The lapillus of *Bagarius yarrellii*, a fish found in the rivers of India, is particularly small viewed in relation to the size of the fish. *Synodontis schall*, a Siluroid from the Nile, has but a small lapillus.

MORMYRIDÆ.

Mormyrus kannume (fig. 4), a fish from the Nile, has a lapillus of a roughly circular outline, although it is the largest of its three otoliths; it is moderate in size considering the size of the fish.



LAPILLI.

1. *Neoceratodus fosteri.* 2. *Arius buchanani.* 3. *Platystoma fasciatum.* 4. *Mormyrus kannume.* 5. *Hyodon alosoides.* 6. *Megalops atlanticus.* 7. *Osteoglossum bicirrhosum.* 8. *Myletes ellipticus.* 9. *Leuciscus cephalus.* 10. *Murænesox talabon.* 11. *Polynemus tetradactylus.* 12. *Macrurus investigatoris.* 13. *Gadus morrhua.* 14. *Lutjanus annularis.* 15. *Lopholatilus chamæleonticeps.* 16. *Sciæna carutta.* 17. *Sciæna maculata.* 18. *Pagellus erythrinus.* 19. *Drepane punctata.* 20. *Osphromenus olfax.* 21. *Caranx malabaricus.* 22. *Sarda mediterraneus.* 23. *Psettodes erumei.* 24. *Trigla cuculus.* x 2

HYODONTIDÆ.

The lapillus of *Hyodon alosoides* is shown enlarged (fig. 5). It is fairly developed for the size of the fish.

The following fishes to be described do not belong to those in which the lapillus is the largest of their otoliths:—

ELOPIDÆ.

Megalops atlanticus (the Tarpon) has a very well developed lapillus (fig. 6), of roughly circular outline, with a dent in part of it.

OSTEOGLOSSIDÆ.

The only specimen of a lapillus obtained in this family was got from the head of *Osteoglossum bicirrhosum*, the "Aroowana" of British Guiana; it is a small stone of triangular shape (fig. 7).

OSTARIOPHYSI.

The *Siluridæ* have been dealt with above. The lapillus in the families of the *Characinidæ* and *Cyprinidæ* occupies the second place in size of their three otoliths. It is generally of a fair size; in some cases it may even be classed as large.

CHARACINIDÆ.

Myletes ellipticus, the "Pacu" of British Guiana (fig. 8), has a lapillus of fair size, enabling the lines of growth to be distinctly traced. The lapillus of *Macrodon trahira*, the "Haimara" of British Guiana, is of elongated shape. That of *Erythrinus salmoneus*, called the "Yarrow" in British Guiana, assimilates more in shape to that of *Myletes*.

CYPRINIDÆ.

Leuciscus cephalus (the Chub) has a particularly solid lapillus (fig. 9) which has two little projections, one terminating as a slight hook. An extra lapillus was found in the right half of the cranium of a *Leuciscus dobula* (the Dace); in a specimen examined it is mentioned as being most abnormal. There were two lapilli in the labyrinth of the right side and one in that of the left side.

APODES.

Murænesox talabon, called the "Koolaree" by the Tamil fishermen at Madras (fig. 10), has a well-developed lapillus, shaped like a grape-seed. In *Conger vulgaris* it is a well developed stone also.

POLYNEMIDÆ.

Polynemus tetradactylus, called the "Mangoe" fish at Calcutta (fig. 11), has a fairly large lapillus for the size of the fish, and the largest in this family. In *P. indicus*, *P. plebeius*, and *P. sextarius* the lapilli decrease in size in the fishes in the order named.

MACRURIDÆ.

In *Macrurus investigatoris*, from the Indian Ocean (fig. 12), the lapillus is small, of a generally circular shape, with a feeble double projection at one side.

GADIDÆ.

In this family the lapillus is not correspondingly developed to the size of the sagittæ. *Gadus morrhua* (the Cod) (fig. 13) has one of a roughly quadrate shape and rather lumpy.

SERRANIDÆ.

The lapillus of *Lutjanus annularis* is of a grape-seed shape (fig. 14); this should be given a quarter of a turn to the right to get the shape defined.

PSEUDOCHROMIDES.

Lopholatilus chamæleonticeps (the Tilefish) (fig. 15) has, compared to its sagitta, but a very moderately-sized lapillus, of a grape-seed shape.

SCIÆNIDÆ.

In this family the lapilli vary in size; some have a large one, e. g. *Sciæna carutta* (fig. 16), of oblong shape, with a concave border one side, whilst others have a comparatively small one, e. g. *S. maculata* (fig. 17); both these specimens came from the Indian Ocean, and in the adult stage grow to much the same size.

SPARIDÆ.

Pagellus erythrinus (fig. 18). The outline of the stone comes to a pointed projection in one part. *P. centrodontus* (the Sea Bream) has an oblong outline with a projection at one angle. *Box salpa*, a Mediterranean fish, has a solid little lumpy stone with a projection adhering to it. *Pagellus mormyrus*, also from the Mediterranean, is similar in shape to *P. centrodontus*, but without the projection. *Sargus rondolettii*, from the Mediterranean, is similar in shape, with the corners more rounded as to three of them, the fourth making a projecting point.

DREPANIDÆ.

Drepane punctata (fig. 19). The stone is of a grape-seed shape.

OSPHROMENIDÆ.

Osphromenus olfax (the Gourami) from Java (fig. 20) has a very small lapillus of an irregular rhombic shape, with one corner running into a little spike.

CARANGIDÆ.

The lapillus of *Caranx malabaricus* (fig. 21), from the Indian Ocean, is of fair size and has two jutting-out spikes from one corner, with another corner rounded; it is roughly quadrate. *C. trachurus* (the Horse Mackerel) has a grape-seed-like lapillus.

SCOMBRIDÆ.

The lapillus in this family, like the other otoliths, is small. *Sarda mediterraneus* (fig. 22) has it of a pear shape.

PLEURONECTIDÆ.

In this family the lapilli are small. *Psettodes erumei* (fig. 23), from the Indian Ocean, has its lapillus shown; the shape is difficult to describe.

TRIGLIDÆ.

Trigla cuculus (fig. 24) (the Red Gurnard) has a pear-shaped lapillus. That of *T. gurnardus* (the Common Gurnard) assimilates to the same shape.

The accompanying illustration has been arranged to show the small black outlines, as nearly as possible, of the natural size of the lapilli illustrated. The larger drawing at the side of each is not to scale, but enables some of the markings and sculpturing to be appreciated.

A CATALOGUE OF THE LAND AND FRESHWATER MOLLUSCA OF SUSSEX.

By E. W. Swanton.
(Member of the Conchological Society; Curator of the Educational Museum, Haslemere.)

(Continued from p. 181.)

LIST OF SPECIES

(INCLUDING PLEISTOCENE AND HOLOCENE RECORDS).

Testacella haliotidea, Drap.—Occurring only in gardens and nurseries, therefore probably an introduced species. Rother District (Rev. E. N. Bloomfield); Cornwallis Park, Hastings (E. A. Butler); garden at Park Crescent, Brighton (R. M. Christy, 'Zoologist,' 1880, p. 367); garden at Ratham, near Chichester (W. Jeffery); Lewes (T. S. Hillman).

Var. *major*, G. & F.—Alman's Nurseries, Horsham (J. Whitaker).

T. scutulum, Sowerby.—Occurring in similar situations to the preceding, and probably an alien. Mr. W. Jeffery introduced it in 1881 into his garden at Ratham, Chichester; Lewes (J. H. Jenner); Hastings (Butler); Rectory garden at West Stoke, near Chichester (Rev. W. A. Shaw); Horsham (R. D. Darbishire); Bognor (H. L. Guermonprez).

Var. *aurea*, Cockerell.—Horsham (R. D. Darbishire).

Limax maximus, L.—Generally distributed in woods and near houses.

Var. *cinereo-niger*, Wolf.—Up Park (W. Jeffery, J. C. v. 134); Stoughton (Rev. W. A. Shaw).

Subvar. *ornata*, Lessona.—Up Park (W. Jeffery).

Var. *concolor*, Pini.—Worthing (T. D. A. Cockerell).

Var. *cellaria*, D'Argenville (= *maculata*, Picard).—Bognor (H. L. Guermonprez); Blackdown (E. W. S.).

Var. *krynickii*, Kaleniczenko (=*johnstoni*, Moquin-Tandon). —Bognor (H. L. Guermonprez).

L. flavus, L.—Generally distributed.

Var. *maculata*, Kaleniczenko. — Considered by Taylor to be a subvar. of *umbrosa*, Phil. Ratham, Chichester (W. Jeffery).

L. arborum, Bouchard-Chantereaux.—Widely distributed in woods and parks, especially abundant in beech plantations.

Agriolimax agrestis, L.—Common throughout the county. Mr. J. P. Johnson found it in Pleistocene deposits on the foreshore at West Wittering.

Var. *albitentaculata*, Dum. & Mort. (= *alba*, Cockerell).—Ratham, Chichester (W. Jeffery).

Var. *nigra*, Morelet.—Ratham (W. Jeffery); garden in Queen's Park Road, Brighton (F. G. S. Branwell).

Var. *lilacina*, Moquin-Tandon.—Midhurst (T. D. A. Cockerell); gardens at Blackdown House (E. W. S.).

A. lævis, Müller.—Apparently rare, but probably often overlooked. It is an active species, occurring chiefly in the vicinity of water. It exhibits remarkable sex changes: at first unisexual and purely female, it becomes hermaphrodite, and finally purely male by the atrophy of the female organs. Mr. P. J. Johnston found it in the Pleistocene deposit on the foreshore at West Wittering. Ratham, near Chichester (W. Jeffery); near Liphook (Rev. S. Spencer Pearce); Blackdown (E. W. S.); Charlton Forest (E. W. S.).

Milax sowerbyi, Férussac.—A local species; easily recognized by the prominent and pale dorsal keel. Lewes and Battle (J. H. Jenner); Ranscombe (C. H. Morris); Little Common, near Bexhill (Rev. W. A. Shaw); Hastings, rare (Rev. E. N. Bloomfield); Ore (A. E. Craven); garden in Queen's Park Road, Brighton (F. G. S. Branwell); not uncommon about Henfield and at Hassock's Gate, near Hurstpierpoint (W. Borrer); common in the Weald and also on the South Downs (J. E. Harting); Bognor (H. L. F. Guermonprez); near Pulborough (E. W. S.); West Stoke, near Chichester (Rev. W. A. Shaw).

M. gagates, Draparnaud.—Rare, recorded only from the neighbourhood of Hastings. It differs from its congener in the darker colour and dark dorsal keel. Hastings (Miss E. B. Fairbrass); East Rother District (J. H. Jenner).

Vitrina pellucida, Müller.—Generally distributed.

Var. *depressiuscula*, Jeffreys.—Hastings and St. Leonards (Langdon's 'Natural History of Hastings,' 1878, p. 13); near Hastings (Hastings Philosophical Society).

Vitrea crystallina, Müller.—Generally distributed. Mr. J. P. Johnson found it in a buried river deposit on the foreshore at West Wittering.

V. cellaria, Müller. — Generally distributed. It has been found in Holocene deposits at Eastbourne and at Cissbury.

Var. *albina*, Moquin-Tandon.—Landport, near Lewes (C. H. Morris); West Stoke (Rev. W. A. Shaw).

Var. *margaritacea*, Schmidt. Landport, near Lewes (C. H. Morris).

Var. *compacta*, Jeffreys.—Steyning (Rev. C. E. Y. Kendall).

V. rogersi, B. B. Woodward (= *Zonites glaber*, Jeffreys).—Rare. Eastbourne (F. H. Sikes); Guestling (A. J. Alletsee); Charlton Forest (E. W. S.); East Dean (C. E. Wright); Cowdray Park (E. W. S.).

V. alliaria, Miller. Generally distributed, the most abundant representative of the genus on the Vectian sands.

Var. *viridula*, Jeffreys.—West Stoke, uncommon (Rev. W. A. Shaw).

V. nitidula, Draparnaud.—Generally distributed. Recorded by Mr. J. P. Johnson from the buried river deposit on the foreshore at West Wittering.

Var. *helmi*, Alder.—Lewes (C. H. Morris); Up Park and West Stoke (Rev. W. A. Shaw).

V. pura, Alder.—Generally distributed.

Var. *margaritacea*, Jeffreys.—Lewes (C. H. Morris); Ashcombe plantation (J. H. A. Jenner); Chichester district (W. Jeffery); Valewood Park, near Haslemere (E. W. S.).

V. radiatula, Alder.—Generally distributed.

Zonitoides nitidus, Müller.—A gregarious species, locally abundant in marshy situations. Mr. J. P. Johnson found it in the Pleistocene deposit exposed at low tide on the foreshore near West Wittering, at the extremity of Bracklesham Bay. Ouse, Cuckmere, and East Rother districts, not common (J. H. Jenner); Malling Marshes and Landport, Lewes (Jenner); by the ditches in the levels at Lewes, rare (W. C. Unwin); Pevensey Level

(Ralph Tate and E. A. Butler); Arundel and Chichester district (W. Jeffery); Bognor (H. L. Guermonprez).

Z. excavatus, Bean.—A rare species. A single specimen under dead fir-bark in St. Leonards Forest (W. Borrer); Piplye, Horsted Keynes (W. Whitwell); stream side, Rowfant, Tilgate Forest (E. Saunders); Midhurst (W. Jeffery).

Euconulus fulvus, Müller.—In damp situations throughout the county. Mr. J. P. Johnson noted it in the river-bed deposit at West Wittering.

Arion ater, Linné.—Generally distributed.

Var. *albo-lateralis*, Roebuck.—Singleton, near Chichester (W. Jeffery).

Var. *castanea*, Dum. & Mort.—Ratham, Chichester, not uncommon (W. Jeffery); around Heyshott (E. W. S.).

Var. *plumbea*, Roebuck.—Near Liphook (Rev. S. Spencer Pearce); near Pulborough (E. W. S.).

A. subfuscus, Drap.—Very local; common on the Vectian sands. Charlton Forest (E. W. S.); Bognor (H. L. F. Guermonprez); Henley, near Midhurst (E. W. S.); Blackdown (E. W. S.); Up Park (W. Jeffery).

Var. *cinereo-fusca*, Drap.—Up Park (W. Jeffery).

A. intermedius, Normand (= *A. minimus*, Simroth).—This species and the preceding are probably of much greater frequency than indicated by the records. It is the smallest British representative of the genus, very distinctive in the pointed rugosities (each with a projection on the apex) arranged in symmetrical rows. Charlton Forest (E. W. S.); Verdley, near Midhurst (E. W. S.); Blackdown (E. W. S.); near Liphook (Rev. S. Spencer Pearce). "This doubtful species is included in the Hastings list without locality" (Jenner).

A. hortensis, Férussac.—Generally distributed.

Var. *subfusca*, C. Pfeiffer.—Gardens at Blackdown House (E. W. S.).

A. fasciatus, Nilsson (= *A. circumscriptus*, Johnston).—Probably often confused with the preceding species. Ore and Coghurst (Craven); Frant (E. W. S.); Charlton Forest and about Heyshott (E. W. S.); Worthing and Pulborough (E. W. S.); garden at Ratham, and Up Park (W. Jeffery); Verdley, near Midhurst (E. W. S.).

Var. *subfusca*, Roebuck.—Blackdown (E. W. S.).

Punctum pygmæum, Drap.—Frequent on the Downs. Mr. J. P. Johnson found it in the Pleistocene deposits at West Wittering. Lewes Downs, under chalk stones (J. H. A. Jenner and W. C. Unwin); Ashcombe plantation (Eastbourne Nat. Hist. Soc.); among leaves at Hurstmonceaux (Hastings Phil. Soc.); "Hastings (Diplock's Guide), not recently found" (J. H. A. Jenner); Hassocks (P. F. Kensett); Cowfold, near Horsham (W. Borrer); Harting (J. Weaver); Downs above Heyshott and Cocking (E. W. S.); about Chanctonbury Ring and Cissbury (E. W. S.).

Sphyradium edentulum, Drap.—Locally abundant. Chailey Common, Lewes, rare (W. C. Unwin); Downs, Lewes (J. H. A. Jenner); Cow Gap, Eastbourne (Eastbourne Nat. Hist. Soc.); Cowfold (Borrer); Bognor (H. L. F. Guermonprez); Harting (J. Weaver).

Pyramidula rupestris, Drap. — Widely distributed on old walls.

Var. *umbilicata*, Montagu.—Ratton, near Willingdon (G. K. Gude).

P. rotundata, Müller.—Generally distributed. Mr. J. P. Johnson records it from the buried fluviatile deposit on the foreshore at West Wittering; and the Rev. W. A. Shaw has found it in a Holocene bed at Kingley Vale, West Stoke.

Var. *alba*, Moquin-Tandon.—Ranscombe and Landport, near Lewes (C. H. Morris); Wannock, near Eastbourne (Rev. S. S. Pearce); between the links and Compton Road, Eastbourne (Jenner); West Stoke (Rev. W. A. Shaw).

Monst. *scalariforme*.—Ringmer (T. S. Hillman).

P. ruderata, Studer.—This species differs from the preceding in the more produced spire, fewer whorls, and absence of reddish-brown freckles. Unknown in Britain in the living state. Mr. J. P. Johnson records it from the old river-bed at West Wittering. It has also been found in Pleistocene deposits in Kent, Essex, and Cambridge.

Helicella virgata, Da Costa.—Widely distributed; very abundant on the Downs. It shows great variability in size and markings. Specimens an inch in diameter were collected by the Rev. S. S. Pearce in cultivated fields at Eastbourne; large specimens have also been recorded from Lewes by Mr. Jenner, and from Chichester by Mr. Jeffery. Minor forms have been observed on the Lewes Downs (T. S. Hillman) and about Hastings.

Var. *alba*, Bouchard-Chantereaux. — Newhaven (Jenner); roadside near Glynde (Jenner); Winchelsea; Friston, near Eastbourne (C. H. Morris); Rodmell, near Lewes (C. H. Morris); near Bexhill (Rev. W. A. Shaw).

Var. *nigrescens*, Grateloup. — Lewes (Jenner); Winchelsea (specimen in the Rufford collection, Hastings Museum); near Beachy Head, and in Kingley Vale, near Chichester (Rev. W. A. Shaw).

Var. *leucozona*, Taylor.—Wilmington (Jenner); Winchelsea (Hastings Phil. Soc.).

Var. *hypozona*, Moquin-Tandon.—Seaford and Alfriston (J. H. A. Jenner); Winchelsea (A. J. Alletsee).

Var. *submaritima*, Jeffreys.—Winchelsea (A. J. Alletsee); "a form approaching this colouring occurs on the Lewes Downs" (Jenner); Downs above Heyshott (E. W. S.).

Var. *subalbida*, Poiret.—"Seaford, Newhaven, and several other localities" (J. H. A. Jenner): Downs about Cissbury (E. W. S.); Chilgrove, near Chichester (Rev. W. A. Shaw); Downs above Heyshott (E. W. S.).

Var. *albicans*, Grateloup.—Seaford and Newhaven (Jenner); Lewes (C. H. Morris); Winchelsea (A. J. Alletsee); Chilgrove, near Chichester (Rev. W. A. Shaw); Downs above Heyshott (E. W. S.).

Var. *radiata*, Hidalgo.—Winchelsea (A. J. Alletsee); Little Common, near Bexhill (Rev. W. A. Shaw).

Subvar. *picta*, Jenner. — Occurs not uncommonly near Rye (J. H. A. Jenner).

Var. *lutescens*, Moquin-Tandon.—Winchelsea (specimens in the Rufford collection, Hastings Museum); Downs above Heyshott (E. W. S.).

Monst. *sinistrorsum*. Near Stoughton (Rev. W. A. Shaw).

(To be continued.)

NOTES AND QUERIES.

MAMMALIA.

A Strange Nesting Association of the Squirrel and the Sparrow-Hawk.—Whilst rambling with a friend in June last through the wooded valleys of Gyffylliog, in Denbighshire, we found a Sparrow-Hawk's nest in a large alder tree at the foot of Foel Uchaf. On climbing to the nest, which contained four young and one egg just upon hatching, I flushed a Squirrel from its drey, which was situated immediately under the Hawk's nest. The Sparrow-Hawks had evidently used the Squirrel's drey as a foundation for their nest, and the two nests were practically what might be termed a two-storey domicile. It was evident from the foulness of the Squirrel's portion that the latter had probably been in occupation during the whole of the time of the incubation period of the Hawk, which was sitting within but a few inches above.—J. Steele Elliott.

AVES.

Increase of Little Grebes (Podiceps fluviatilis) Nesting in Bedfordshire.—Thirty years ago the Little Grebe continued to nest not uncommonly on all the larger lakes, and on many of the smaller pools, ballast-holes, and other water-pits about this county, as also, several pairs at least, along the River Ivel. About 1890 and for several years thence I made frequent visits to all the previous known nesting haunts, and all other likely waters, but with perhaps the one exception of Battlesden Lake they had already, or within a few years, ceased to breed anywhere in the county. It was not until 1909 that I first noticed them again in the nesting season, at Southill, one of their former favourite breeding haunts, and one over which I had kept very careful observation. Four pairs were seen on April 10th, and were calling freely, and no doubt eventually nested, but I was unable to follow up further observations that year. The year following I found several nests with eggs at this lake. From that date they seem to have been on the increase generally throughout the county, and now practically nest once again in all their former haunts; and there are indications that they will become still more common. Until the present year I never knew of them nesting on the River Ouse, although, as already stated, they have been known to have nested on its tributary, the River Ivel; and in 1913 I found them also on the River Lea. In June last I found a pair nesting at Great Barford, and also another pair at Willington, and I have little doubt they will also be found in other localities along that river.—J. Steele Elliott.

On the Laying of the Cuckoo (Cuculus canorus).—Two consecutive week-ends I spent on the River Ouse and its tributary the Ivel, in Bedfordshire, working upon the distribution of the Reed-Warbler. Finding two of their nests containing eggs of the Cuckoo, without a doubt laid by the same bird, I kept a careful look-out for any additional nests that might also be used by this same Cuckoo. Over sixty nests of Reed-Warblers in all were found on a stretch of six and a half miles of the Ouse, and a few other nests along the River Ivel, within a mile of the junction of the two rivers. The completed clutches of the Reed-Warbler varied from three to five eggs. Of these nests, eight had been selected by a Cuckoo, and five of them contained eggs laid by this one bird, to which the following particulars refer:—

June 5th.—River Ouse, Blunham. Nest in reed-bed alongside river. Eggs, one Cuckoo with two Reed-Warbler. Incubation about eight days.

5th.—River Ouse, Blunham. Nest in reed-bed alongside river, fifty yards' distance. Eggs, one Cuckoo with three Reed-Warbler. Incubation about three days.

12th.—River Ouse, Great Barford. Nest in reed-bed on an island, one mile distant up stream. Eggs, one Cuckoo with one Reed-Warbler. Incubation about seven days.

11th.—Near River Ivel, Tempsford. Nest in osier-bed and nine feet high, one mile distant east. Eggs one Cuckoo with three Reed-Warbler. Incubation about three days.

12th.—River Ouse, Blunham. Nest in reeds alongside river, half-mile distant up stream. Eggs, one Cuckoo with three Reed-Warbler. Eggs fresh.

The distances are taken from the first nest found. The other three nests found containing eggs of the Cuckoo were all at a greater distance away than any in the above area. In stating to what extent each clutch had been incubated, I had not previously considered the space of time that would have elapsed between each laying, and if my conclusions are about correct, the eggs would have been laid on May 28th, June 2nd, 5th, 8th, and 12th respectively, and this points to the probability that an egg was actually laid every third day. I did not visit this locality again after June 12th, so I cannot say if any additional eggs of this clutch could have been found. The number of eggs of the foster-parent taken by the Cuckoo from these nests I am unable to state, but from the particulars already given, at least two appear to have been extracted from several of the nests.—J. STEELE ELLIOTT.

Late Stay of Fieldfares in North of Ireland.—I was greatly interested in Mr. Wilson's note in your issue for June, stating that a flock of Fieldfares were seen by him near Aberdeen on May 13th, which were much later than the flock I observed near Lurgan, which were seen on April 28th, although this is, I think, an unusually late date for them to be so far south.—W. H. WORKMAN, M.B.O.U. (Belfast).

Some Migration and other Notes for June.—We had to wait until June 15th before we saw a Wheatear, when we met with two males at Bridgend, Kildrummy. We have not seen any more of them. On the same date we saw about twenty Long-tailed Tits at Glenlogie. This is the second season I have seen them here. There have undoubtedly been some specimens of the White Wagtail during June here. Saw a Whinchat on moor ridge near Kildrummy policies on June 30th; it was a male and seemed to have a mate and to be breeding. I have noted two birds on July 1st, which I believe are Bramblings. At Battle Hillock I heard the unusual call of a male here for a female. The former was pretty tame, and flitted about upon a bush of broom, hopping along a branch in search of insects, in a way I never saw Chaffinches do. He next made an appearance upon gooseberry bushes in the garden, picking up caterpillars. Whatever be the cause, there is a great crop of the latter, giving much trouble. Have not as yet heard a Corncrake. Warblers seem rather quiet as regards song.—W. WILSON (Aberdeen).

Sparrow Robbing Starling.—On Whit-Monday I was watching a pair of Starlings hunting on a very small grass-plot in Ridgmount Street, W.C.; the cock had got a bill full of what appeared to be worms (which one often sees Starlings get on London lawns) when a Sparrow made a dart and snatched his booty from him. He then started chewing it but would not allow a very close approach, going off into some shrubs; the Starling went on hunting, without showing resentment. If the objects seized really were Earthworms (as I believe), it is curious that a Sparrow should steal what one never sees it catch for itself; but American naturalists accuse the Sparrow of watching their "Robin" (*Turdus migratorius*) hunting worms, and then appropriating his prey just as this Sparrow did with the Starling.—F. Finn.

Quadruple Duck-hybrids at Kew.—This year there have been bred at Kew a brood of duck-hybrids of quadruple descent. The mother was a hybrid between a Chilian Wigeon (*Mareca sibilatrix*) and a duck which was itself a hybrid between the African Yellow-billed Duck (*Anas undulata*) and the Madagascan Meller's Duck (*A. melleri*); the father was a Chilian Teal (*Nettion flavirostre*). The birds thus bred are unlike any of the four species concerned in their origin; they were as large as their mother, and of a light brown colour, with the back much darker, and a sooty-black cap contrasting with the whitish cheeks and fore neck; in two the brown colour is reddish and uniform; in the other three it is more of a clay colour and slightly mottled, and the light edges to the back-feathers are more clearly defined. The inner secondaries, next to the "tertials," are pale slate-grey, as in the Red-crested Pochard (*Netta rufina*); the speculum, in the only one in which I could see it, was slaty-black with a white edge.—F. Finn.

CRUSTACEA.

Abnormality in Edible Crab.—On June 18th I received a female Crab of about 2 lb. weight which showed only one genital orifice, on the right side. This was in the usual position and of the normal size, and there was no sign whatever of the corresponding one of the left side.*—F. H. Brooks.

INSECTA.

Vanessa antiopa actually in Camberwell District.—In the summer of 1873, when returning to my father's house—East Dulwich House, on East Dulwich Green—I found a Camberwell Beauty Butterfly, which I still have in my possession, in a Spider's web. It was very much alive but necessarily had become a very poor specimen through being in such a position. Of course it would have been of no use had it not been practically extinct in these islands. It has the *white* band round the wings, but it is a wreck.—Walter Morgan.

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* We are much indebted to Mr. Brooks for having shown us this specimen.—Ed.

NOTICES OF NEW BOOKS.

Annals of Tropical Medicine and Parasitology. Vol. ix. No. 1. Liverpool: 1915. 7*s*. 6*d*. net.

In the March number of this valuable publication, Dr. H. Bayon gives a long and interesting account of the experimental study of leprosy, a disease still, unfortunately, well known in hot countries, and lingering in several of those of Europe. "However," says this author, "the ruthless individual and, in some cases, collective segregation in the thirteenth and fourteenth centuries, aided, no doubt, by the improving hygienic conditions of all classes, succeeded in bringing about a practically complete extinction of leprosy in Middle Europe and Great Britain. In addition to this, various plague epidemics also helped in sweeping to an early grave, in a somewhat selective fashion, the vagrant and pauper lepers sooner and quicker than individuals belonging to better situated classes." It is considered that the communicability of leprosy has been fully established, and that the disease can be transferred experimentally to animals, though not readily. The spontaneous disease of rat leprosy shows much resemblance to the human disorder, and may yet be found to be etiologically related to it. Observations on the metabolism of white men living in the Tropics are contributed by Mr. W. J. Young, who in this first paper deals with the protein metabolism, and finds that the results, so far as they go, exhibit no marked variations from the averages obtained in temperate climates. Papers of more definitely zoological character are those on the species of mammalian lung-flukes of the genus *Paragonimus*, infesting man as well as other mammalia, by Messrs. H. B. Ward and E. F. Hirsch, and on new species of Tabanid Flies from Africa, by Mr. H. F. Carter. The papers are well illustrated by plates.

Brazil. By J. C. Oakenfull. 1913 & 1914. 7*s*. 6*d*.

Two editions of this most useful and comprehensive publication are to hand, but in the department which concerns us there is no alteration; it would be well in fact if there had been a little in the zoological section, since there are some errors in the naming, &c. For instance, the Emu is credited to Brazil, whereas this is simply the Portuguese name of the Rhea, also, and in this case correctly mentioned; and the celebrated plumes of the Egret or "garça" are said to be taken from the head of the male, whereas they are found in both sexes, and only occur on the head as well as the back in the smaller species (*Leucophoyx candidissima*), the large and widely-distributed White Egret (*Herodias*) having them on the back only. However, the two chapters on the fauna form interesting and useful reading, as also do the remarks on live stock. It is satisfactory to hear that the "Zebus" or humped Oriental cattle have been successfully introduced into a climate so suitable for them, and very interesting as well that the purely red Devon among our own breeds puts on more weight than the Durham or Hereford Ox. Among poultry, the Leghorn and Plymouth Rock are mentioned as thriving well, and it may be more than a coincidence that both these are yellow-legged breeds. The latter has a good name in this country for resisting cold and wet, and so has the Romney Marsh Sheep, another home breed which is well suited, it appears, to tropical conditions, so that special breeds of domestic animals, as well as species of wild ones, like the common Rat and Rock-Pigeon, may at times exhibit hardiness in face of opposite climatic conditions. The Goat is noticed as thriving, as in Europe, where other beasts would starve.

The Austral Avian Record. Edited by Gregory M. Mathews. Vol. ii. No. 7. London: Witherby & Co. 1915. 1*s.* 6*d.*

This publication, which is, in the present instance, written as well as edited by Mr. Mathews, is "devoted primarily to the study of the Australian Avifauna"; the department of that study, with which it is especially concerned, appears to be the determination of names and the description of new subspecies, so that it is not necessary to do more than draw attention to its existence in a periodical which concerns itself so little with such subjects as does the 'Zoologist.'

Report of the Punjab Department of Fisheries. Lahore. 1914. 9*d.*

This first and annual report of the Fishery Department in the Punjab has some valuable information on the subject of fish-culture in that part of India. Fish-culture in that country labours under many difficulties; poaching is rampant, and besides the natural enemies we are used to here in the shape of Cormorants, Kingfishers and others (all far more numerous than in Britain), there are Crocodiles to be reckoned with! It is satisfactory to know, however, that the skins of these repulsive reptiles have a definite commercial value, the North-west Tannery Company having, it seems, issued a pamphlet on the skinning and packing process, and being willing to pay the equivalent of 1*s.* 2*d.* and 8*d.* per running foot for belly and tail pieces respectively.

Report on the Trout-cultural Operations in the Punjab, &c. By G. C. L. Howell. 4*d.*

This report, which covers the period from October, 1912, to the end of March, 1914, deals with the culture of introduced Trout in the Punjab and Native States under its control—Kulu, Simla Hills, Chamba, and Kangra. All India is entirely outside the range of the Salmonoids, their place in the Himalayan streams being taken by such fish as the "tasteless Mountain Barbel (*Oreinus sinuatus*)." There is thus a large range suitable to Trout and entirely open to them, and as Mr. Howell says, "To fill waters, which contain no fish worth eating, with the best of all freshwater fishes, can at least do no harm to anybody, while no conceivable circumstances can destroy the capitalized value of a good head of Trout in this or any other country." It is therefore gratifying to know that Brown Trout, already introduced into Kashmir, from which the ova have been obtained for these experiments, promise to do well in the localities dealt with, and that Rainbow Trout, which are suitable for warmer waters, are being experimented with.

Hand-list of the Birds of Borneo. By J. C. Moulton, B.Sc., M.B.O.U. From Straits Branch Royal Asiatic Society's 'Journal,' December, 1914.

Mr. Moulton is the Curator of the Sarawak Museum, and has here given us an up-to-date hand-list of the rich bird fauna of Borneo, which will be of much use to ornithologists. Subspecies are distinguished by italics, and placed after the name of the describer of the typical form of the species, the subspecies describer's coming last, thus:—"*Argusianus argus*, Linn., *grayi*, Elliott. The Bornean Argus Pheasant." This is a good practical way of dealing with the subspecies problem, as far as clearness goes, though it might be pointed out that when we have to use five words as the name of a given form, we are getting near the old-fashioned plan of a brief description of the species, to be used as its name, without its advantages of intelligibility. Moreover, although, as in the case of the bird quoted, the reduction of a form to subspecific rank is often an advantage both from the practical and scientific point of view, there is a tendency to overdue lumping, as when Mr. Moulton suggests that the largest form of the well-known Hill- or Talking-Mynahs (*Eulabes javanensis*) is probably a subspecies of the smallest or South Indian form (*E. religiosa*); the birds in this case being quite as different as the Carrion-Crow and Raven. There is an interesting disquisition in the Introduction on the evolution of nomenclature, but, although we fully recognize the utility of such lists as the present, one cannot understand why naturalists in the Tropics should worry about closet subjects at all, and we have full sympathy with our author's plan of relegating all proposed alteration of names to his footnotes.

Junior Botany. University Tutorial Press, Ltd. London, 1915.

The study of field zoology is intimately connected with botany—indeed, we understand that one of our best known field botanists in this country commenced his Nature studies as an entomologist—so that, although we do not desire botanical books for review in the 'Zoologist,' it may be pointed out that the present manual is clearly written and well adapted for laying the foundations for botanical knowledge. Stress is particularly laid on experiments, which are far too much neglected by zoological students. The only direct references to animals in the book are naturally the descriptions of plant-devices for fertilization and seed-dispersal by the aid of animals.

The Auk. New series, vol. xxxii. Nos. 1, 2. Cambridge, Mass. U.S.A. 1915. 3 dols. yearly.

There is much good matter in the first two numbers of this Journal of the American Ornithologists' Union that have appeared this year, but some that is rather depressing reading. We are told by Mr. Henry K. Coale in the January number of the threatened extinction of the Trumpeter Swan (*Olor buccinator*),* the largest of the known Swans, as it slightly exceeds the Mute Swan in size, though in all other respects it closely resembles the Whooper, save for having the bill and face all black; and Dr. R. W. Shufeldt gives some notes on the last specimen of the formerly super-abundant Passenger Pigeon (*Ectopistes migratorius*) known to have existed, a specimen which was bred in captivity in the Cincinnati Zoo and died there at the age of about twenty-nine years. What happens to American birds when they get rare is well illustrated by Mr. Frederic H. Kennard's paper "On the Trail of the Ivory-bill," in which he tells us hardly anything about this splendid Woodpecker, now apparently confined to Southern Florida, except that he shot the only one he saw.

Such cynical destructiveness on the part of people who are supposed to be naturalists makes the execution wrought by those who kill for economic reasons pardonable by comparison; there is enough of this in all conscience in the valuable records of the past history of the Wild Turkey, diligently collected by Mr. Albert Hozen Wright; these are classified according to political divisions and arranged in chronological order, and occupy considerable space in both numbers to hand. It is noteworthy that the older writers quoted, speaking of the days of early settlement, when white men were scarce and Turkeys common, constantly mention forty pounds as the weight of adult males; it would thus seem that the northern race of Wild Turkey in its palmy days grew quite as large as the less known Mexican wild form from which our tame birds were originally derived, though this has been credited with larger size. Several authors also refer to the Indian stuffs of a plush-like character made by weaving Turkey-feathers with twine. Mr. John C. Phillips discusses his attempts to discover what possible effects acclimatization has had on the Common Sparrow in America; but this philosophical enquiry has proved difficult to prosecute, as collectors, both professional and amateur, would not or could not bother about Sparrows. What data were to hand led to the conclusion that the enquiry would be better called "A study of the stability of a species under wide-ranging climatic and geographical conditions."

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* *Cygnus buccinator* of the 'British Museum Catalogue of Birds,' vol. xxvii.

In the April number Mr. Frederic H. Kennard has a paper on the "Okaloacooche Slough in Florida," embodying notes on the Burrowing Owl, with figures of its burrow—he says that the Owls "never seemed to sleep, day or night" (we have observed that most Owls in the Zoo, except Barn-Owls, seem usually awake); on the Roseate Spoonbill, rather absurdly called locally "Pink Curlew," and other waders, and a curious observation on the Swallow-tailed Kite, a specimen of which continued to fly over his head after its wing had been broken at the pinion joint by a shot.* Why he should have been shooting a bird like this, perfectly well known, absolutely harmless, and, as he remarks, of exceeding beauty, at the beginning of its breeding-season, he does not say. Dr. Winsor U. Taylor writes on the simultaneous action of birds, and suggests as an explanation that telepathic power, more greatly developed in them than in man, is responsible for their concerted actions. Among the shorter notes in this number is found a well-known indictment against the Cape May Warbler (*Dendroica tigrina*) as a destructive consumer of grape-juice in Pennsylvania; it is estimated that all unbagged grapes were ruined by this "little striped yellow bird" in the autumn of 1913, the loss amounting to many tons, worth several hundred dollars.

British Birds. Vol. viii. Nos. 8–12. Vol. ix. No. 1. London: Witherby & Co. 1915. Monthly. 1*s*. net.

The January number of 'British Birds' does not begin a new volume, the eighth volume ending in the May number, while June inaugurates volume nine. There are some excellent papers in these half-dozen numbers, including several by Miss M. D. Haviland, who deals with the breeding-habits of the Curlew-Sandpiper, Little Stint, and Grey Phalarope, as observed by her recently in Siberia. The notes are accompanied by photos, some of them very good. Mr. J. H. Owen has some good notes in the January number on the food and habits of the Sparrow-Hawk; he enumerates as birds he has known killed,

* There is, or was recently, at St. James's Park, a Black-headed Gull which flew freely about, although minus half a wing through pinioning, and a splendid pair of Common Herons at Kew had learnt to fly though pinioned, and ultimately disappeared.

besides the small common kinds, Pheasants, Wood-Pigeons, Turtle-Doves, Partridges, Great and Lesser Spotted Woodpeckers, and Cuckoos; he has seen a Teal chased very hard, and a young Moorhen picked off a pool; Blue Tits were brought to a nest he watched "more often than might be expected." Mr. H. W. Robinson, in the February number, records the results of ringing Black-headed Gulls, and a very gratifying ringing record is that by Mr. J. S. Allison, in the April number, of his having rung, fed and released a Little Gull—no doubt the first, as he suggests, to be rung under the scheme—which had been caught in a Plover-net near Louth, Lincolnshire. On the same page Mr. Clifford Borrer records seeing a Glaucous Gull in St. James's Park among Herring-Gulls. As he speaks of its "milky-white" plumage, it could surely not have been adult as he suggests, the stage in which the plumage is creamy-white all over being intermediate between the mottled young plumage and the grey-backed white adult dress, in which the most obvious difference from the Herring-Gull (besides the size) is the absence of black on the primaries. The disappearance of some Bearded Tits introduced from Holland, at Hornsea Mere, is noted from the 'Naturalist,' to the satisfaction of the editors, who deprecate "this interference with Nature." They have, however, nothing to say against the destruction of six Dusky Thrushes (*Turdus fuscatus*) recorded in April also, five of which were shot at the same spot, at Hollington, in Sussex, and included both sexes, between January and March; evidently they think that, though it is interfering with Nature artificially to extend the range of a species, there is no interference about killing down the pioneers, when extension of range is taking place naturally! There are, of course, in these numbers plenty of other records of the killing of birds found outside their usual range, but none so far new to the country. A remarkable note is that of Mr. H. E. Forrest in the January number of the fowl-like tameness of a Redwing in Shropshire, which for a fortnight had accompanied a man employed in spreading sods, to feed on small life exposed. In the March number Mr. O. G. Pike has some notes and fine photographs of the Fulmar at home. In the June number Mr. A. H. Macpherson records a Mistle-Thrush singing on the wing, and Mr. E. H. Wendy has a similar record for both this species and the Blackbird; we ourselves once heard a Blackbird do this in the Zoo grounds, and the curious thing was that it was carrying a worm at the time. Another remarkable Thrush-record, in the March number, quoted from the 'Scottish Naturalist,' is that of a Blackbird and a Song-Thrush feeding on daisy-flowers, in the latter case the subject being a young bird thus fed by its parent. In the June number Mr. R. M. Barrington lists the occurrences of the Common and Black Redstarts at light-stations in Ireland; of thirty-five Common and eighty Black, twenty-six of the former and thirty-two of the latter were killed striking, the rest being shot, caught, or found dead. The records are interesting, but here again we cannot help feeling colonization is being checked. A nine-page paper opening this number, and thus the new volume, by the authors of the 'Hand-List of British Birds' (Messrs. Hartert, Jourdain, Ticehurst and Witherby), discloses the fact that after the dismissal of many well-known names in this publication and the introduction of others, in quite a number of cases, further research has shown that the familiar name has got to be restored. Some particular cases are astonishing: the American Bittern is restored to its previous rank as a species, having been degraded to a subspecies of our Bittern in the 'Hand-List,' though it differs not only in colour and pattern of plumage but in note. The Golden-eye Ducks, too, are allowed a genus of their own again, after being lumped with the Pochards in the List, though their real affinities are with the Mergansers. Species and subspecies splitting is bad enough, but lumping can evidently be equally so. In this supplementary paper we are told we must not call the Common Flamingo *Phœnicopterus antiquorum* any longer, but *Phœnicopterus ruber antiquorum*, because it is only a subspecies of the red American Flamingo, differing "only in degree of coloration." This is not so; both species may be seen at the Zoo alive, and noted to differ in height and proportions (the red bird being shorter and stouter), in colour of beak, and in the shade of the red where both have it, on the wing-coverts. Evidently a good deal of ignorance is needed to manipulate British bird-names in the method approved in Germany and too often elsewhere.

ERRATA.—P. 248, for *Halia[illegible]ur* read *Haliastur*.

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